ENERGY AND ELECTRICITY REVIEW

Energy in the form of electricity affects the daily life of nearly every American. The electricity we depend on is produced by many energy sources.

1.1 Energy in Our Lives

What is energy?

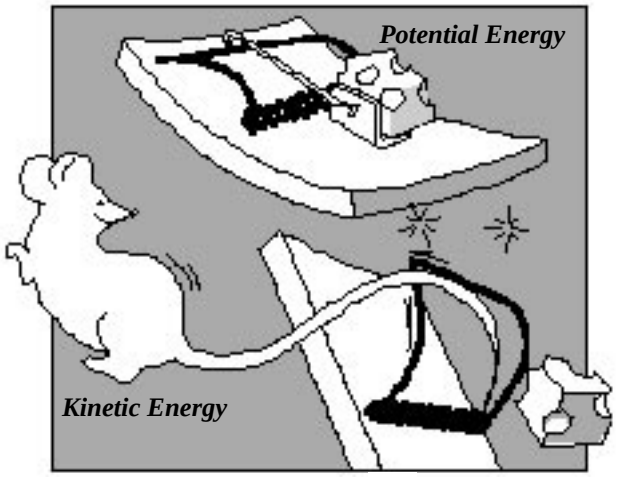
We use energy all the time. Whenever work is done, energy is used. In fact, energy is defined as the ability to do work. For instance, the amount of force needed to move an object may use up part or all of the available energy. All activities involve use of energy. Here are some of the things we need energy for:

- To power our factories and businesses
- To heat and light our homes and schools
- To run our appliances and machines
- To fuel our cars, airplanes, and ships
- To run television and films
- To use our telephones and computers
- To make our food and clothes

1.2 Kinetic and Potential Energy

What are the types of energy?

We can divide all energy into two basic types: *potential energy* and *kinetic energy.* Potential energy is stored energy that is waiting to be used. A mousetrap that has been set has potential energy; but if a hungry mouse accidentally trips it, the potential energy is changed into energy in action, known as kinetic energy. Heat, light, and motion all show that kinetic energy is present and is being used. Potential energy is often harder to detect. It must be changed into kinetic energy before we can use it.



A set mousetrap has potential energy. When sprung, the energy in action is called kinetic energy.

1.3 Energy Forms

What are the forms of energy?

There are many forms of potential and kinetic energy. These include mechanical, radiant, thermal, electrical, chemical, and nuclear.

- *Mechanical energy* is the energy of motion. Mechanical energy turns the wheels of a car.
- *Radiant energy* is the energy in light. The Sun's energy comes to us in this form.
- *Thermal energy* is heat energy, which is released when fuel is burned or a liquid is boiled.
- *Electrical energy* is the movement of *electrons,* one of the three basic particles that make up an atom. Electric current is the continuous flow of millions of electrons through a conductor, such as a copper wire.
- *Chemical energy* is the energy released when the chemical composition of materials changes. When baking soda is mixed with water the mixture bubbles. A chemical reaction is occurring and chemical energy is released.
- *Nuclear energy* is released when certain atoms (the smallest units of matter) change the makeup of their centers. Sometimes they split apart, or sometimes two centers are forced together.

Just as stored energy can be changed to active energy, the above forms of energy may be converted to one or more different forms. For example, when electrical energy reaches a lightbulb, the temperature of the bulb's center is changed to release both thermal and radiant energy as heat and light. Other examples of how energy forms change are given throughout this reading lesson.

1.4 Energy Sources

Much of Earth's energy comes from the Sun in the form of radiant energy. Plants convert this energy to chemical energy by using a process called photosynthesis. This new chemical energy is stored in the form of sugars and starches, which provide energy for the plant to grow as well as for animals that eat the plant. When we burn plants such as trees, stored potential energy is released immediately in the form of thermal energy (heat) and radiant energy (light), which we call fire. Chemical energy is also released as the composition of the wood fuel changes to ash.

Where does energy come from?
What energy comes from the Sun?

Radiant energy from the Sun makes some parts of Earth warmer than other parts. Air surrounding these warmer surfaces is heated, causing it to rise. Cooler air from the less heated surfaces then flows in to replace the heated air that has risen. This flow of air is called wind.

What causes wind?

Radiant energy from the Sun can also cause water to evaporate and turn into water vapor, which rises into the upper atmosphere where it forms clouds. The tremendous energy in storms and winds is actually caused by the Sun's radiant energy.

Over millions of years, countless plants and animals died and were slowly buried beneath the ground, where they were compressed. The chemical energy stored in them was concentrated in oil, coal, and natural gas. These fuels, created from animals and plants that lived long ago, are called fossil fuels. Fossil fuels currently provide about 70 percent of all our energy.

What are fossil fuels?

The four main, or primary, energy sources that we use today are:

What are primary energy sources?

- fossil fuel energy (coal, natural gas, oil);
- geothermal energy (heat from inside Earth);
- nuclear energy (uranium and plutonium); and
- solar energy (Sun).

In addition to the primary energy sources, there are also secondary energy sources, which are produced by using the primary sources. Electricity is a secondary source of energy that can be produced by using any of the primary sources mentioned above.

What is a secondary source?

Water power, wind power, the wood we burn, and the food we eat are other secondary sources of energy that come from the primary source of the Sun.

What are nonrenewable and renewable sources?

Fossil fuels are thought of as primary energy sources, even though they originally took their energy from the Sun. Because it takes millions of years to make fossil fuels, there is a limited amount of these fuels on Earth. Consequently, fossil fuels are a nonrenewable energy source, and when we have used them up, they will be gone. Nuclear fuels, such as uranium and plutonium, are also nonrenewable energy sources. Geothermal and solar energy are called renewable sources because they cannot be used up.

1.5 Energy Conversion

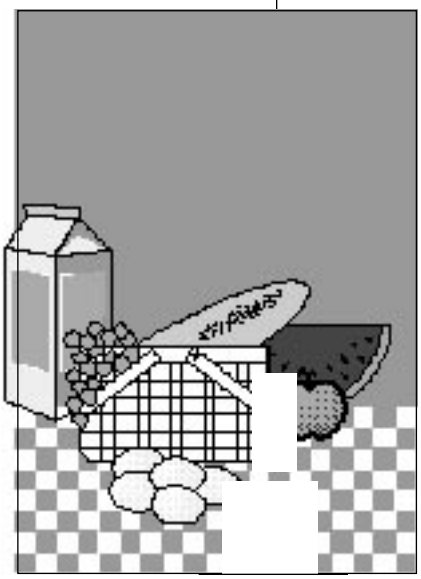
How do we convert energy from one form to another?

As shown earlier, energy can change from one form into another, but it cannot be created or destroyed. In fact, when we say that we use energy, we simply mean that we change it or harness it to do the work that we need done.

We are always losing heat energy. This lost energy cannot be used again. It is similar to helium balloons that escape into the sky. They still exist, but we can no longer enjoy them. We must constantly put energy into things, or they will run down.

What is energy conversion?

Changes in the types and forms of energy happen in hundreds of ways every minute. For instance, inside our bodies many different energy conversions take place constantly. Chemical energy in food enables us to walk and talk. In order to walk or run, and to keep our hearts beating, our bodies must convert the chemical energy in food into other forms of energy such as mechanical and thermal energy. Burning gasoline to power cars is another energy conversion process that we rely on. The chemical energy contained in gasoline is converted to mechanical energy.



Our bodies convert the chemical energy in food into mechanical and thermal energy that allows us to function.

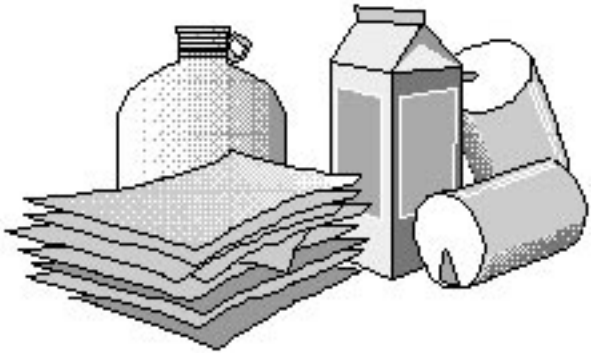
When we exercise, we also produce heat energy. You can easily feel this heat when you do a lot of work because your

body will heat up. This happens because the process used to transform the chemical energy in your food into mechanical energy is not very efficient.

In fact, most energy conversion processes are not very efficient, and as a result, they lose energy to the environment. Only about a quarter of the energy that we use in our bodies and automobiles is transformed into mechanical energy. The rest is lost as heat. When a conversion process wastes a lot of energy, it is called inefficient.

The inefficient conversion and use of energy costs money and wastes nonrenewable resources. This is why people today are looking for ways to save energy by carefully using our energy sources and trying to convert energy as efficiently as possible.

1.6 Conservation



Recycling household waste is one way we conserve energy.

Saving energy is called conservation. Although conservation is not an energy source, we can use it to extend the length of time nonrenewable energy sources will be available in the future. Energy conservation is something that we all can practice by being careful about how much energy we use. Things that we can do to conserve energy include driving less and carpooling; insulating our homes; making sure thermostats are set correctly; recycling glass, metals, and paper; and turning off lights and appliances that are not being used. As conserving energy becomes more important, manufacturers are starting to make more efficient machines. Choosing automobiles and appliances that use energy efficiently is another way we can practice energy conservation.

How can energy be conserved?

1.7 Electricity

Shifting Energy Sources

While we once relied heavily on primary fossil fuels such as wood, fuel oil, coal, candles, etc., use of electricity proved more efficient, versatile, and even cleaner than these energy

In the past, our energy needs for cooking, heating, and lighting were met using primary energy sources, most often by the burning of fossil fuels. Of all the forms of energy used today, electricity (a secondary source of energy) is the one we rely on most in our day-to-day lives. In fact, we are so accustomed to using electrical energy that we tend to take it for granted—until service stops and everything comes to a halt. One reason we use so much electricity is that it is our most versatile and adaptable form of energy. We use it at home, at school, and at work to run numerous machines and to heat and light buildings.

What is electricity?

What is electricity? To the scientist, it is the flow of electrons, usually through a wire. However, sometimes we see it in the sky as lightning or experience it as static electricity when hair is attracted to a comb or when someone takes off a sweater and there is a crackling sound.

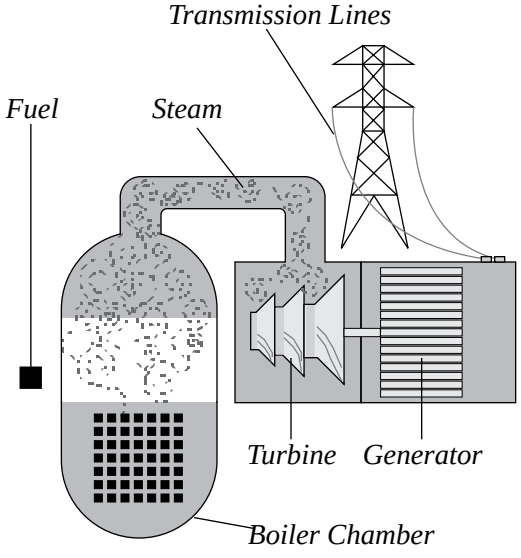
1.8 Generating Electricity

How is electricity produced?
From what sources is electricity generated?

Electricity is generally produced at a powerplant by converting one of the sources of energy into electricity. In the United States, the source is usually a fossil fuel (coal, oil, or natural gas), uranium, or water. Solar power, wind, *biomass,* or geothermal energy can also be used.

Most powerplants are very similar in several important ways. Most are designed to generate electricity by heating water to produce steam. The steam is then directed against the blades of a turbine, making it spin in the same manner air makes a windmill spin. A coil of wire attached to the shaft of the generator spins inside a magnet. This causes electrons to flow in the coil—and the flow of electrons is electricity.

Electric Generating Plant



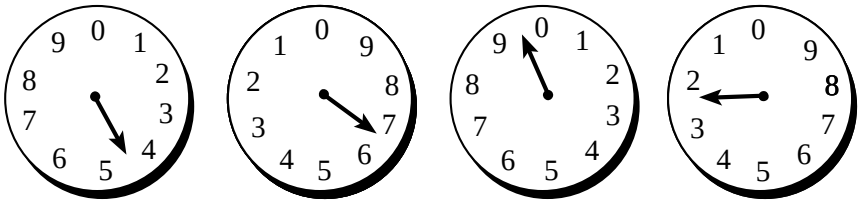
1.9 Transporting Electricity

How do we get electricity to the place where we use it?

The electricity produced in the generator is sent out over wires to homes, schools, hospitals, farms, and factories. Getting it there is not a simple job.

The generating plants and wires are owned and operated by about 1,000 different electric power companies all across the Nation. These companies must build powerplants, string wires or bury them underground, buy fuel for the plants, and hire workers to do all the jobs that must be done. As you can imagine, all that takes a lot of money.

That is why the users of electricity must pay to use it. Meters keep track of how much electricity travels from a power company's wires into homes, businesses, schools, and factories. The company sends a worker to read the meter to determine how much each user must pay and sends the user a bill.



Meter boxes measure how much electricity a consumer uses.

1.10 Electric Utilities

Companies that sell electricity are called utilities. A utility provides something useful or essential to the public, like electric power, gas, water, or telephone service. Because a utility provides an essential service to its customers, it has special duties. For instance, it must be able to supply all the electrical needs of its customers. A utility can't promise to deliver its product in two weeks the way some other companies can. Therefore, an electric utility must have generating plants, fuel, and sufficient power lines ready to do their jobs at any instant.

It would be wasteful and costly if more than one electric company served the same group of customers. Each company would have generating plants, fuel, power lines, and workers. So, a utility is assigned a specific area to serve, and no other electric company may sell electricity in that area. In exchange for that privilege, State and

local governments regulate the utility. They tell a utility how much it can charge, what services it must provide its customers, and how much profit it can make.

Because an electric utility must serve the needs of the public, it must plan carefully so that it can produce enough electricity. Decisions made today must anticipate the public's need for electricity in the future. These decisions are very difficult because it can take as long as ten years to build a fossil fuel powerplant or fourteen years to complete a nuclear powerplant. This means that utilities must act on predictions of what customers will need in the future.